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Integrity - Service - Excellence

Food Poisoning

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Mandatory Overview

- What is the problem?
  - Limit the Scope
  - Basics
- Too much information
  - Clinical
    - What does it look like?
    - How do you fix it?
  - Public Health
    - How can it be prevented?
  - Food Science
    - Cool trivia (might be handy to know!)
- What you should remember

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Sources of Food Toxins

- Industrial Chemicals (Cleaners, Environmental Contaminants)
- Pesticides
  - Used to control vermin in processing plants
  - Sprayed onto FFV
- Contaminated Water
- Pathogenic Bacteria
- Aquatic microorganisms
- Finfish Spoilage

We'll limit discussion to microorganisms causing foodborne intoxications…

Foodborne Illness (2 types)

1. INFECTION
   - **Ingestion of MICROBES IN FOOD**
   - **Illness Caused by:**
     - **Invasion and direct insult to the gut / body**

       or
     - **Toxin production in the GI tract**

       (“toxin-mediated INFECTION”)

Foodborne Illness (2 types)

2. INTOXICATION --
   - **<u>Ingestion of FOOD CONTAINING TOXIN</u>**
   - **Causes:**
     - **Microbes produce toxin while growing in food**
       - **Ingestion of the microbes themselves may be harmless**
     - **Microbes produce toxin while growing in environment, concentrate in food tissues**
     - **Chemical contamination of food**

Staphylococcal Gastroenteritis

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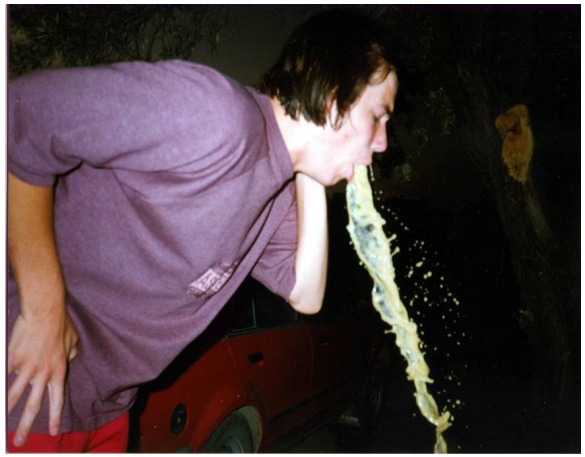

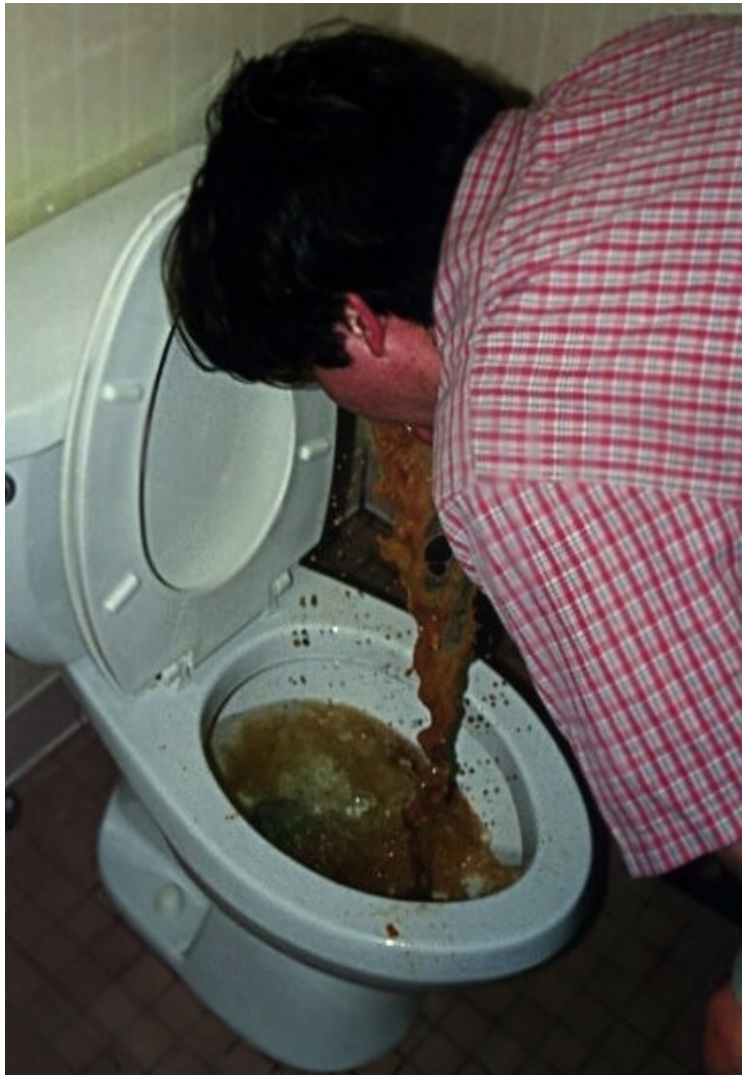

Staphylococcal Gastroenteritis

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Clinical

- **Cause:**
  - Heat-stable toxin produced during growth of *S. aureus* in food
- **Symptoms:**
  - Primarily vomiting, with severe nausea and cramping, diarrhea +/-
  - Sometimes subnormal temperature and mild hypotension
  - Rarely fatal
- **Incubation period:**
  - 30 minutes (or less?) to 8 hours
  - Usually 2 - 4 hours
- **Diagnosis:**
  - Clinical, epidemiologic
  - Culture of vomitus, stool, or food may be negative
- **Treatment:**
  - Supportive, fluids if indicated

Staphylococcal Gastroenteritis

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Public Health

- **Reporting:**
  - Not reportable
  - Report outbreaks (>2 cases, same source) to Public Health Office
  - Rationale: caused by poor food hygiene; investigation may prevent further cases of illness
- **Prevention:**
  - *S. aureus* is common on human skin and in nasal cavity
  - Food workers with purulent lesions must not contact food!
  - Standard food hygiene: time, temperature, cleanliness
  - The bacteria is killed by cooking, the toxin is *not*!
- **Control:**
  - Identify food source (epidemiologically)
  - Investigate food preparation practices & foodhandlers

Staphylococcal Gastroenteritis

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Staphylococcal Gastroenteritis

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Food Science

- **Toxin production:**
  - ***S. aureus* must multiply in food to produce enough toxin to cause illness (>10^6 CFU/gm)**
  - **Amino acids and B vitamins needed (animal origin foods)**
  - **Wide temperature range: 10 – 46°C (optimum = 40 – 45°C)**
  - **High salt, low a_w foods (reduces competition)**
  - **pH range: 4.0 – 9.8 (homemade mayonnaise)**
- **Typical foods:**
  - **Foods of animal origin**
  - **Foods that are handled directly**
  - **Pork products, cream-filled pastries, casseroles**

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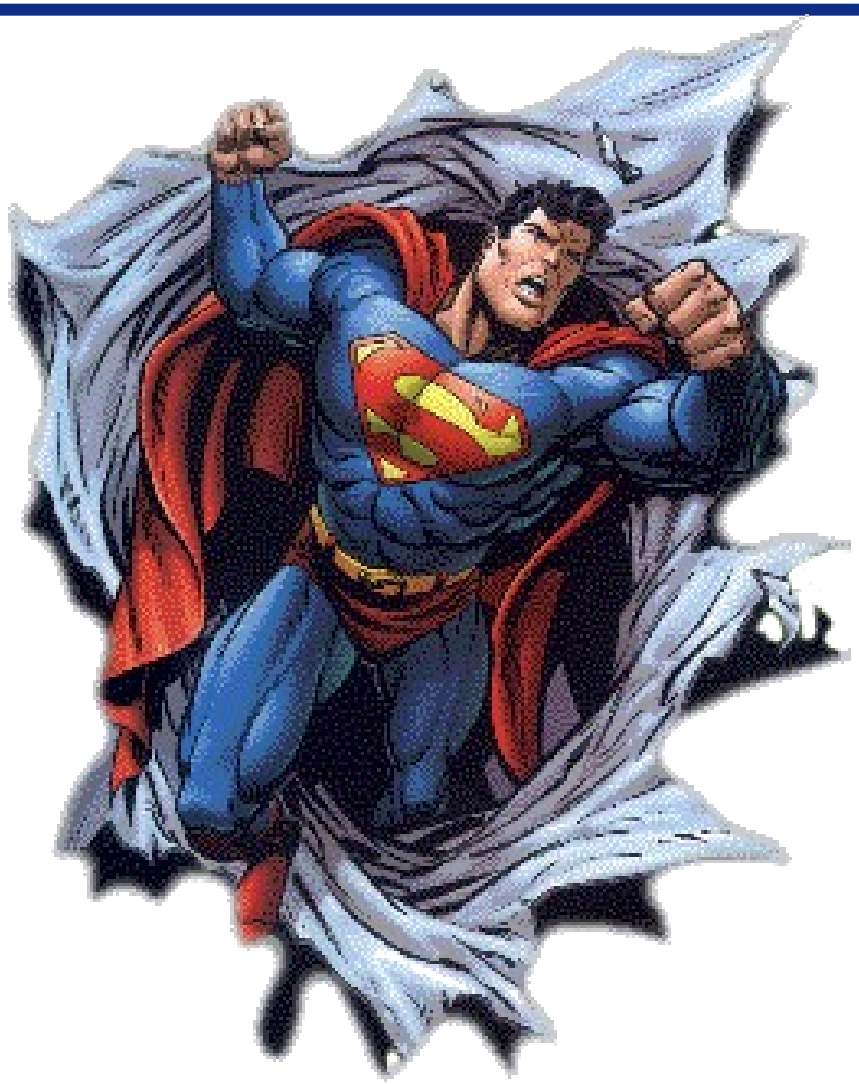
Perfringens Diarrhea



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Perfringens Diarrhea

Clinical

- **Cause:**
  - Heat-activated spores of *Clostridium perfringens* grow in food
  - Toxin produced during growth of pathogen in small intestine
- **Symptoms:**
  - Profuse watery diarrhea, with severe gas
  - Nausea and cramping, but no vomiting
  - Rarely fatal
- **Incubation period:**
  - 6 to 24 hours, symptoms persist 12 – 24 hours
- **Diagnosis:**
  - Clinical (Small bowel diarrhea + GAS)
  - Culture of stool and/or food may be helpful
- **Treatment:**
  - Supportive, fluids if indicated

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Perfringens Diarrhea

Public Health

- **Reporting:**
  - Report outbreaks (>2 cases, same source) to Public Health
  - Rationale: caused by poor food handling; investigation may prevent further cases of illness
- **Prevention:**
  - *C. perfringens* spores are common in soil, water, milk, dust and in human GI tract
  - Often found in raw meat and spices
  - Standard food hygiene: time, temperature, cleanliness
  - The spores are activated by cooking, then grow in warm food
- **Control:**
  - Identify food source (epidemiologically)
  - Investigate food preparation and holding practices

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Perfringens Diarrhea

Food Science

- **Toxin production:**
  - ***C. perfringens* must multiply in food to high numbers (>10^7 CFU/gm)**
  - **Cooking temperatures activate spores to germinate**
  - **Doubling time: 8 – 10 minutes (Fast!)**
    - Theoretically, go from 1 organism to 10^7 in 3.2 hours
  - **"Violent" fermentation of lactose in the lab**
  - **Grows well in small intestine, produces toxin and lotsa gas**
  - **Anaerobic, but fairly aerotolerant; optimum growth temp > 20°C**
- **Typical foods:**
  - **Meat casseroles prepared one day & served the next day**
  - **Thanksgiving turkey → stuffing left in the bird warm**
  - **Chili in a large pot → inadequate cooling in fridge**

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B. cereus Gastroenteritis

Clinical

- **Cause:**
  - Heat-activated *Bacillus cereus* spores *(*and other *Bacillus* spp.*)* grow in food
  - Toxin produced during growth of pathogen in food
- **Symptoms:**
  - Two separate syndromes: diarrheal and emetic
  - Sudden onset; either colic & diarrhea, or nausea & vomiting
  - Lasts less than 24 hours; usually relatively mild illness
- **Incubation period:**
  - Emetic: 1 to 6 hours; Diarrheal: 6 to 24 hours
- **Diagnosis:**
  - Culture of stool and/or food may be helpful
  - Enterotoxin testing helps, but usually not available
- **Treatment:**
  - Supportive, fluids if indicated

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B. cereus Gastroenteritis

Public Health

- **Reporting:**
  - Report outbreaks (>2 cases, same source) to Public Health
  - Rationale: caused by poor food handling; investigation may prevent further cases of illness
- **Prevention:**
  - *B. cereus* spores are common in soil, dust and water
  - Often found in raw meat, milk and GRAINS
  - Standard food hygiene: time, temperature, cleanliness
  - The spores are activated by cooking, then grow in warm food
- **Control:**
  - Identify food source (epidemiologically)
  - Investigate food preparation and holding practices

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B. cereus Gastroenteritis

Food Science

- **Toxin production:**
  - ***B. cereus* must multiply in food to high numbers (>10^7 CFU/gm)**
  - **Cooking temperatures activate spores to germinate**
  - **Emetic Syndrome**
    - Very similar to Staphylococcal enterotoxin, but less violent
  - **Diarrheal Syndrome**
    - Very similar to *C. perfringens* diarrhea, but less gas
  - **Toxin not denatured even at 121°C for 30 minutes**
- **Typical foods:**
  - **Emetic syndrome: Fried or boiled rice (usually)**
  - **Diarrheal syndrome: Comminuted meats (liver sausage, meat loaf)**
  - **Both: Cereal foods containing starch (mashed potatoes, pudding)**

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Botulism

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Botulism

Clinical

- **Cause:**
  - Heat-activated spores of *Clostridium botulinum* grow in food, wound or gut
  - Toxin produced during growth of pathogen
- **Symptoms:**
  - Cranial nerve impairment and descending paralysis, but alert
  - Vomiting, constipation or diarrhea
  - US case-fatality rate = 5 – 10%, full recovery takes months
- **Incubation period:**
  - 12 to 72 hours, sometimes longer (several days)
- **Diagnosis:**
  - Botulinum toxin in patient or food
  - Culture of stool and/or food may be helpful, but spores are ubiquitous
- **Treatment:**
  - Supportive, assisted ventilation, no antibiotics (esp. aminoglycosides)
  - Adult: IV antitoxin; Infant: botulinal immune globulin (investigational)

Botulism

Public Health

- **Reporting:**
  - Reportable immediately to Public Health (even a single case)
  - Rationale: fatal disease, often caused by improper commercial canning, therefore large group outbreaks are possible;
  - Potential bioterrorism agent (easy to make, low LD_{50})
- **Prevention:**
  - *C. botulinum* spores are common in soil and water
  - Often found in raw meat and vegetables
  - High temperature processing, high acid, nitrite
- **Control:**
  - Identify food source (epidemiologically)
  - Investigate food source and preparation practices

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Botulism

Food Science

- **Toxin production:**
  - ***C. botulinum* must multiply in anaerobic conditions**
  - **Cooking temperatures don't kill spores, but reduce competition**
  - **Toxin denatured by 80°C for 10 minutes, or boiling for 2-3 minutes**
  - **Important toxins for humans: A & B, E in seafood; animals: C & D**
  - **Some strains proteolytic, some are not (Don't taste suspect food!)**
- **Typical foods:**
  - **Home canned food (usually low acid: meats & green vegetables)**
  - **Sous vide (Cook - Chill) foods**
  - **Anaerobic Bizarreness**
    - Garlic in oil
    - Sauteed onions
    - Baked potatoes
    - Fermented fish
    - Homemade jerky
    - Baby guts

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Shellfish Toxins

Quick and Dirty: Filter feeders, toxigenic microbes in water

- **Paralytic Shellfish Poisoning (PSP):**
  - Tingling or burning of lips, tongue and face
  - Paralysis and death in < 12 hours (or, complete recovery!)
- **Neurotoxic Shellfish Poisoning (NSP):**
  - Tingling or burning of lips, tongue and face
  - Symptoms subside within hours (up to 3 days), no sequelae
- **Diarrheal Shellfish Poisoning (DSP):**
  - Diarrhea, vomiting, abdominal pain
  - Symptoms subside within hours (up to 3 days), no sequelae
- **Amnesic Shellfish Poisoning (ASP):**
  - Diarrhea, vomiting, abdominal pain and memory loss
  - Rare fatalities, symptoms usually subside within days, no sequelae

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Finfish Toxins

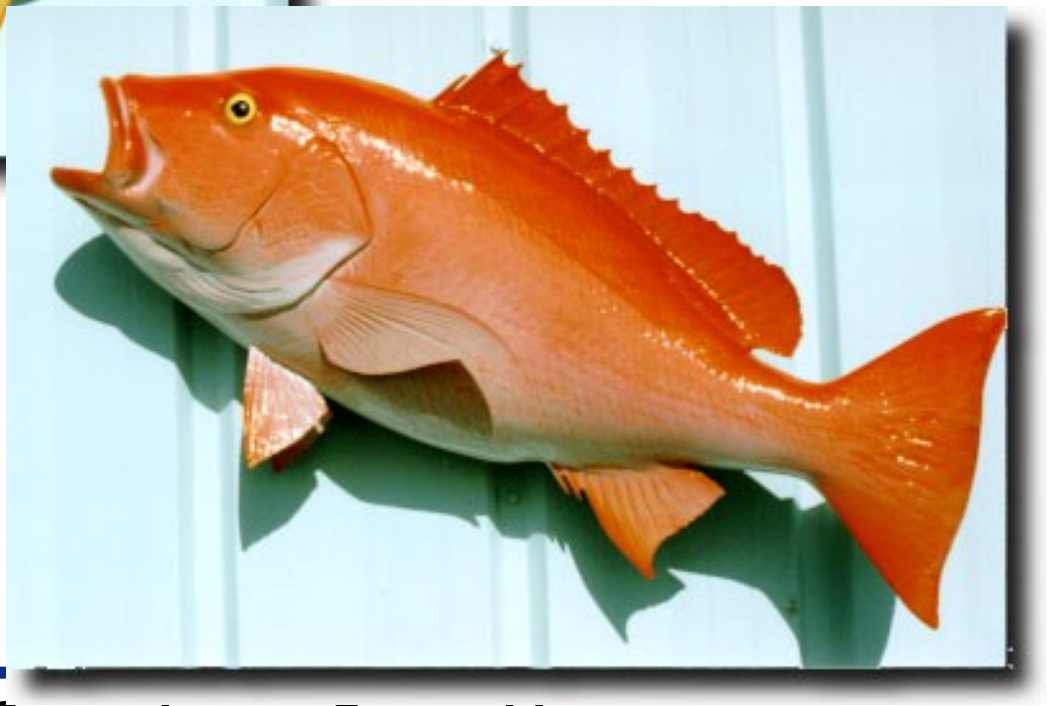
Quick and Dirty: Avoid reef fish and fugu

- **Scombroid Fish Poisoning (Histamine?)**
  - Tingling or burning of lips, tongue and face
  - Caused by bacterial decomposition
  - Symptoms subside within hours (up to 3 days), no sequelae
- **Ciguatera Poisoning**
  - Vomiting, diarrhea within a few hours, neurologic 1-2 days later
  - Perception reversal (eg, cold objects feel hot), teeth feel loose
  - Severe case: hypotension, coma, death within 24 hours
  - Symptoms usually persist for weeks, may return later
- **Fugu (Pufferfish):**
  - Vomiting, diarrhea, dizziness, ataxia, paralysis, death
  - There are cheaper ways to kill yourself

Reef Fish

- Mutton

- Red Snapper



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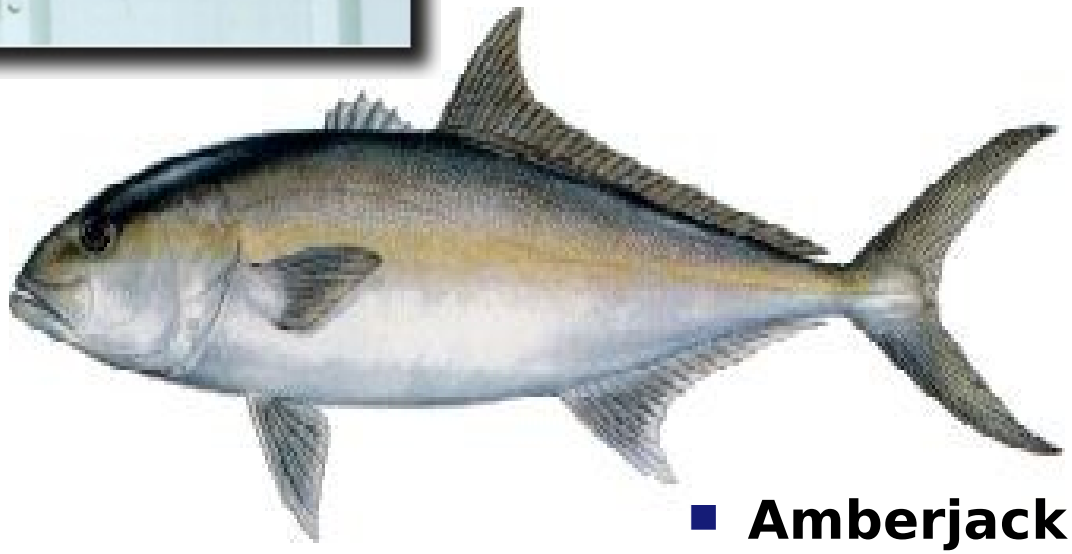
Reef Fish

- Barracuda



- Amberjack

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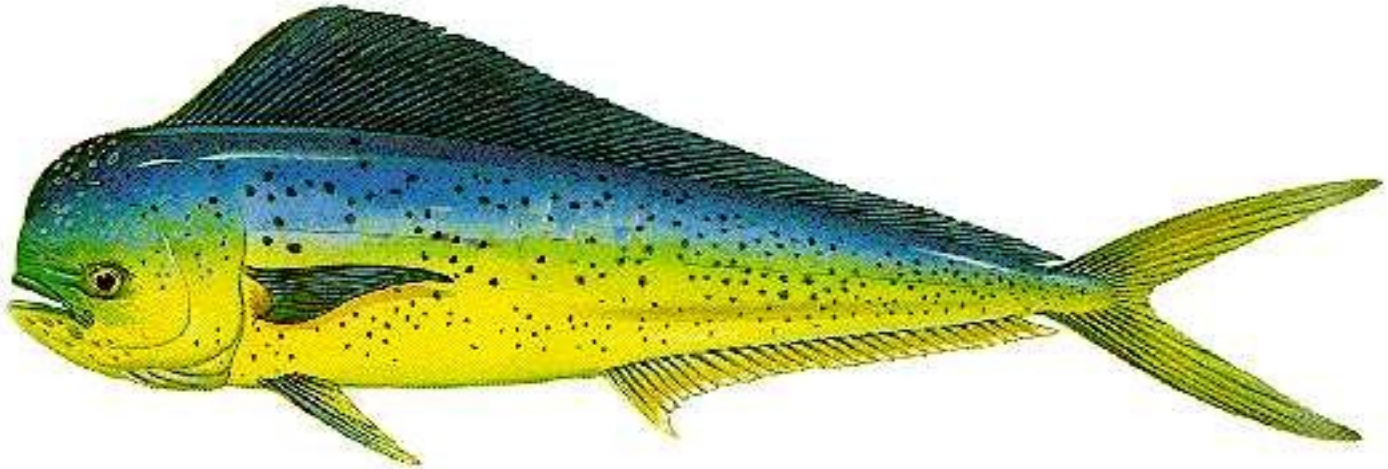
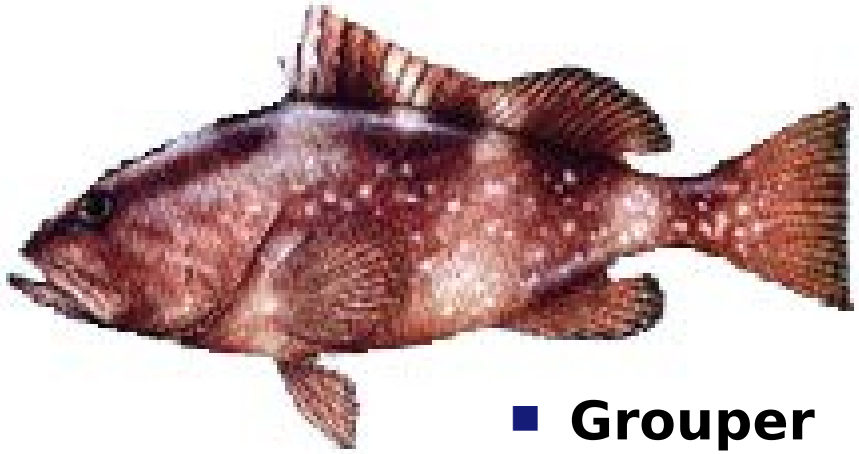
Reef Fish



- Dorado, Mahi-mahi, Dolphinfish



- Grouper

WORLD RECORD
436 3/4 LB
WARSAW GROUPER
Marina
Point
DESTIN, FL
FISH WARSAW
WEIGHT 436¾
DATE 12-22-85
ANGLER Steve Hasenb
BOAT SUNRISE

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Puffer Fish (fugu)

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Other Fish to Avoid (?)

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Other Fish to Avoid (?)

Pop Quiz

- **Large pot of chili cooked last night, left on counter to cool for 3 hours, then put into fridge; reheated and served for dinner. What is the risk?**

A. Staphylococcal enterotoxin
B. Clostridium perfringens diarrhea
C. Bacillus cereus emetic toxin
D. Bacillus cereus diarrheal toxin
E. Botulism
F. All except E

Pop Quiz

- **Patients who ate the chili complain of nausea, abdominal cramps, and watery diarrhea, beginning about 8 hours after eating the chili. Most likely problem?**

A. Staphylococcal enterotoxin
B. *Clostridium perfringens* diarrhea
C. *Bacillus cereus* emetic toxin
D. *Bacillus cereus* diarrheal toxin
E. Botulism
F. B or D

Pop Quiz

- **Your technician notes that same patients who ate the chili also have significant gas. Most likely problem?**

A. **Staphylococcal enterotoxin**
B. ***Clostridium perfringens* diarrhea**
C. ***Bacillus cereus* emetic toxin**
D. ***Bacillus cereus* diarrheal toxin**
E. **Botulism**
F. **B or D**

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Pop Quiz

- **First Shirt buys “marinated” salmon from downtown vendor at bargain price for big fish fry. Within 30 minutes, several people notice tingling of the lips and tongue. Should you panic now?**

A. Yes, because rapidly acting seafood toxins are often fatal
B. Yes, because you approved buying fish from this vendor without consulting with Public Health first
C. No, because the squadron commander is TDY this week
D. No, this is a histamine response that will subside in a few hours
E. B and/or D

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Pop Quiz

- **A patient in Egypt with symptoms of botulism tells you that yesterday he tried a local delicacy: salted, ungutted fermented raw fish ("faseikh"). You call CDC for antitoxin; they have different types. Which do you need?**

A. **Human derived Botulinal Immune Globulin (BIG)**
B. **Polyvalent botulinum antitoxin type AB**
C. **Polyvalent botulinum antitoxin type ABE**
D. **B or C**

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Compulsory Summary

- Consider Food Terrorism Potential
- Staph aureus → Everybody's got it
- Sporeformers → Cooking helps them
- Botulism → Not just in cans anymore
- Shellfish → Know your vendor
- Finfish → Nothing exotic, and no sauce

THE END

Questions?